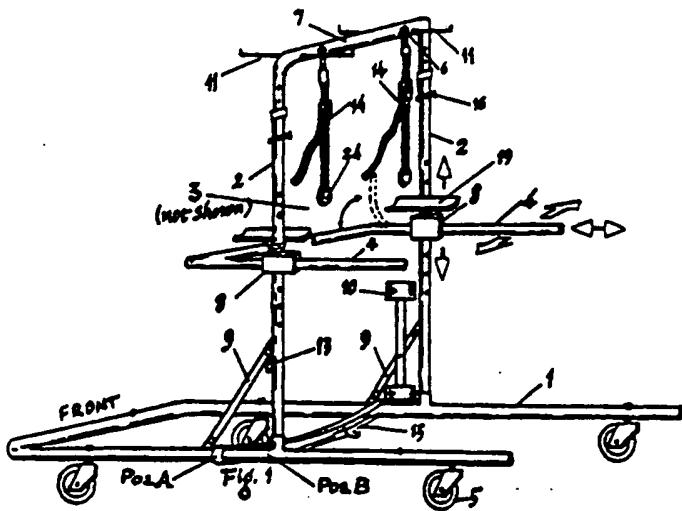




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(54) Title: FALL PREVENTION, AMBULATION, EXERCISE, AND LIFTING ASSIST DEVICE



## (57) Abstract

A fall prevention, lifting assist, exercise, and ambulation medical device for preventing falling or injury of weak, debilitated, or otherwise impaired patients. It may be employed during transfer and walking sessions in rooms or hallways of hospitals, physical therapy units, nursing facility units, and at home. The unit provides access to a chair, wheelchair, commode, hospital bed, standing weight scale, physical therapy mat exercise table, treadmill exercise unit, stationary bicycle exercise unit, or the like. In addition, the unit can simultaneously carry a portable oxygen tank (26), intravenous pump devices, intravenous fluid bottles or bags (25), Foley catheter bag (27), surgical drainage bags, chest tube drainage canister, electronic heart monitor (18), or other such devices. The device incorporates a body harness (3) which is capable of sustaining the entire weight of a patient, and therefore prevent falling and injury of the patient while the device is in use. The device also provides for upper extremity active flexion and extension exercises, and also for quadriceps muscle and knee range of motion exercises via a removable foot anchoring strap (15).

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**FALL PREVENTION, AMBULATION, EXERCISE, AND LIFTING ASSIST DEVICE****CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of the filing of Provisional Application Serial

- 5 No. 60/024,339, entitled "Fall Prevention Ambulation Assist Device, filed on August 22, 1996, and the specification thereof is incorporated herein by reference.

**BACKGROUND OF THE INVENTION****Field of the Invention (Technical Field):**

- 10 The present invention relates to devices for preventing falls of, ambulation of, exercise of, and lifting assistance for debilitated patients.

**Background Art:**

- Patients in medical treatment facilities must receive physical therapy in the form of walking and other exercise in order to build or maintain muscle strength and balance. Many of these patients, however, are impaired by sedating medications, debilitation, malnutrition, obesity, injuries, fractures, amputation of one leg, recent surgical procedures, or mental incapacity. They may also be impaired by medical devices which are attached to them in the course of treatment, such as an oxygen tank, urine Foley catheter, intravenous solution bottles and tubes, mechanical intravenous pump devices, feeding tube pumps, surgical drainage bags, chest tube drainage canisters, and artificial respirators. These patients, therefore, have limited mobility and are in need of additional assistance by one or more medical staff, and they may be in great danger of falling (with subsequent injury) during transfers and ambulation exercise sessions. Often, complicated patients require the assistance of two, three or more personnel to assist them in ambulation, carry medical devices, and to protect them from falling.

There is also often the risk of injury to medical personnel as they attempt to hold, steady, or support a patient who is weak and unpredictable. This can lead to lower back injuries and disability of the medical care-givers as a result of injuries sustained in the course of their employment duties.

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The present invention meets these special needs and challenges of both the patient and the medical personnel attempting to provide physical therapy and ambulation support for the patient.

Previous devices have incorporated various harness designs which can support the patient's weight; however, these have been limited by their design characteristics which do not allow or provide for carrying of necessary medical equipment attached to a patient. These devices are also limited in their ability to provide direct simultaneous access to the bedside, chair, wheel chair, treadmill exercise unit, or other healthcare environments. Some devices cannot provide mobility of the entire unit itself so that patients are unable to ambulate through doors and hallways. Such deficient devices include U.S. Patent No. 5,502,851, to Costello; U.S. Patent No. 4,941,497, to Prather et al.; U.S. Patent No. 4,266,765, to Sandoval et al.; U.S. Patent No. 3,778,052, to Andow et al.; U.S. Patent No. 3,252,704, to Wilson; U.S. Patent No. 2,792,052, to Johannesen; U.S. Patent No. 2,719,568, to Webb; U.S. Patent No. 2,625,202, to Richardson et al.; U.S. Patent No. 2,327,671, to Rupprecht; and U.S. Patent No. 1,611,807, to Bergh.

15

The present invention is a self-contained device for assisting weak or impaired medical patients to walk while wearing a lightweight harness attached to an overhead bar. The harness can therefore fully support his/her weight should he/she fall, lose balance, stumble, become suddenly weak, or even lose consciousness. The supporting overhead bar is attached to an open metal rectangular base frame with rolling casters, which allows the entire unit to be pushed along easily by the patient as he/she strolls.

#### SUMMARY OF THE INVENTION (DISCLOSURE OF THE INVENTION)

The present invention is of an ambulation, exercise, and passive lifting device comprising: a base frame open on a side thereof; a plurality of wheels attached to an underside of the base frame; and a vertical support frame comprising horizontal L-shaped arms open on a side thereof coinciding with the open side of the base frame, the support frame removably attached to the base frame and capable of telescoping at a top end, the support frame further comprising: a series of through-holes to accept securing pins to adjust heights of the arms; a plurality of rods for suspending objects; and a plurality of diagonal bracing rods attached at one end to the base frame and at another end to the support frame, the rods stabilizing the base frame and the support frame and permitting attachment

of accessories. In the preferred embodiment, the arms are removably attached to the support frame and are individually adjustable with respect to height above a floor and with respect orientation to one another, to points forward and rearward distances with respect to the support frame, and to orientation with respect to the floor of forward portions of the arms. A flexible horizontal exercise strap attached to the base frame may be provided for use as a foot anchor and leg exerciser. A suspension harness assembly attached to a top portion of the support frame may be provided for lifting and suspending a body and for prevention of the body from falling. The harness assembly preferably comprises: a plurality of anchors attached to the top portion of the support frame, each capable of fully supporting the weight of the human body; a plurality of shoulder suspension straps which are fully adjustable with respect to length; and a body harness (most preferably a parachute harness). An open cylindrical retaining device may be provided for securing and carrying an oxygen tank, preferably attached to a bracing rod. Attachment means for supporting and carrying medical equipment may be provided, preferably removably attached to a bracing rod. A platform support for supporting weight of a body when an elbow of the body is placed thereon may be provided, preferably removably attached to a side of the support frame. A platform for supporting medical devices may be provided, preferably removably attached to a side of a front portion of the base frame. The sides of the support frame preferably comprise columns for attaching and carrying a plurality of medical devices attachable to intravenous fluid provision poles.

20 An object of the present invention is to provide partial or full support of patient's weight using a comfortable lightweight harness;

Another object of the present invention is to provide free rolling mobility through standard doors and hallways;

25 An additional object of the present invention is to provide access to bed, chair, wheelchair, commode, standing weight scale, physical therapy mat exercise table, treadmill exercise unit, and stationary bicycle exercise unit;

30 Yet another object of the present invention is to provide for carrying of medical equipment attached to a patient;

Still another object of the present invention is to provide protection of individual patients from falling and injury; and

A further object of the present invention is to provide protection for medical personnel to  
5 prevent job-related injuries.

An advantage of the present invention is that it provides features for upper and lower extremity exercise which do not necessarily require walking;

10 Another advantage of the present invention is that it provides capability for passive lifting of a patient from bedside, commode, or chair;

An additional advantage of the present invention is that it provides harness support to allow a patient sit and rest as often as necessary during exercise sessions;

15 A further advantage of the present invention is that it reduces the number of medical personnel necessary to safely accomplish a transfer or ambulation exercise session;

20 Yet another advantage of the present invention is that it provides independent right or left side harness adjustment to allow partial weight bearing on one leg only;

Still another advantage of the present invention is that it provides for passive transfer of a patient over a smooth floor or carpet in the event of an emergency (i.e. returning a distressed patient quickly to bed or chair during an ambulation session);

25 A further advantage of the present invention is that it provides fully adjustable hand-hold bars;

An additional advantage of the present invention is that it provides fully adjustable elbow rest  
30 supports which can allow up to full weight bearing;

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Another advantage of the present invention is that it provides horizontal adjustable hand-hold bars which allow fall protection during "parallel bar" walking therapy.

- Other objects, advantages and novel features, and further scope of applicability of the
- 5 present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

10

#### BRIEF DESCRIPTION OF THE DRAWINGS

- The accompanying drawings, which are incorporated into and form a part of the specification, illustrate several embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating a
- 15 preferred embodiment of the invention and are not to be construed as limiting the invention. In the drawings:

- FIG. 1 is a rear perspective view of the preferred embodiment of the present invention, which also illustrates the position of the quadriceps exercise strap attached to the horizontal base frame,
- 20 and illustrates the position of the right and left adjustable harness support straps;

- FIG. 2 is a side view of the preferred embodiment, illustrating the position of the oxygen tank holder, and position of hanging intravenous bottles and other medical equipment;

- 25 FIG. 3 is a top view of the preferred embodiment which illustrates the position of the flat utility platform at the front of the invention; and

- FIG. 4 is a front view of the preferred embodiment, which also illustrates the harness applied to the human torso, and the position of the adjustable elbow rest supports.

30

DESCRIPTION OF THE PREFERRED EMBODIMENTS(BEST MODES FOR CARRYING OUT THE INVENTION)

The present invention is of a fall-prevention, lifting assist, exercise, and ambulation medical device for preventing falling or injury of weak, debilitated, or otherwise impaired patients. It may be employed during transfer and walking sessions in rooms or hallways of hospitals, physical therapy units, nursing facility units, and at home. The unit provides access to a chair, wheelchair, commode, hospital bed, standing weight scale, physical therapy mat exercise table, treadmill exercise unit, stationary bicycle exercise unit, or the like. In addition, the unit can simultaneously carry a portable oxygen tank, intravenous pump devices, intravenous fluid bottles or bags, Foley catheter bag, surgical drainage bags, chest tube drainage canister, electronic heart monitor, or other such devices. The device incorporates a body harness which is capable of sustaining the entire weight of a patient, and therefore prevent falling and injury of the patient while the device is in use. The device also provides for upper extremity active flexion and extension exercises, and also for quadriceps muscle and knee range of motion exercises via a removable foot anchoring strap.

15

Turning now to the preferred embodiment of the present invention, FIG. 1 illustrates the preferred device of the invention, which comprises three main components: open rectangular base frame 1, open rectangular vertical support unit 2, and horizontal "L" shaped right and left hand support bars 4. The base frame 1, vertical support unit 2, and horizontal hand support bars 4 are constructed of tubular steel or similar alloy. Four free-wheeling/locking caster wheels 5 are attached to the underside of the rectangular base 4, to allow the invention to be pushed freely over the floor surface.

The rectangular vertical support unit 2 is attached and bolted to the midpoint of the side bars of the base unit 1, and further stabilized by the diagonal steel bracing rods 9. The harness support bar 7 of the vertical support unit 2 is designed to telescope into the side bars of the vertical support unit 2 so as to allow adjustment of the vertical height, and is secured by removable holding pins 16.

The right and left hand support bars 4 are attached to the side bars of vertical support unit 2 using machined block metal clamps 8, and secured by removable holding pins or adjustable tightening bolts with lever handles. FIG. 1 depicts the various adjustments and motions in various

- planes of the right and left hand support bars 4 which are fully adjustable. The adjustable hand hold support bars 4 and metal clamp 8 may be made to slide up and down along the side bars of the vertical support unit 2 to adjust height; they can be made to slide forward or backwards through the metal clamps 8 to allow the hand-hold front portions to move variable distances from the body; they
- 5 can be made to angle inwardly or outwardly in the horizontal plane; or they can be made to rotate inside the metal clamps 8 upwards or downwards to allow the hand-hold front portion to fan upwards at desired angles (see FIG. 1).

- The harness support assembly (adjustable support straps 14, and harness 3) are depicted in
- 10 FIGs. 1 and 4. Harness 3 is preferably of parachute-harness design and incorporates adjustable shoulder straps 20, shoulder strap padding strips 21, padded and adjustable leg straps 22, and adjustable horizontal chest strap 23. The harness is of such design that it can be placed and adjusted onto a patient while he/she is in the seated or prone position. Donning of the harness on the seated patient requires little no active participation by the patient. The harness design also allows
- 15 toileting without removal. Variations of harness design may be used to enhance the utility of the entire invention under various environments of use.

- FIG. 1 details the adjustable harness support straps 14 which incorporate a friction locking mechanism, but can be released with finger pressure to allow raising and lowering of the harness as
- 20 much as desired, i.e., from the patient in a sitting position to standing position, and vice versa. Variations of the buckle mechanism can be used. The adjustable harness straps 14 are removably connected to the harness 3 using conventional mountaineering-type carabiner harness rings 24 with spring-loaded locking gates (seen on FIG. 1).

- 25 FIGs. 2 and 4 illustrate the position of various medical equipment devices that can be attached to the present invention. The four utility hanging rods 11 at the top of the telescoping horizontal harness support bar 7 accommodate intravenous bottles or bags 25, and prevent slippage by virtue of the upwardly deflected tip. An oxygen tank 26 can be placed into the oxygen tank holder unit 10 which is attached to either the right or left steel diagonal bracing rods 9. The oxygen tank
- 30 holder itself 10 can be removed as needed by removal of two wing nuts. The utility hook 13 is used to hold a urine Foley catheter bag, surgical drain bag, chest tube canister, or the like. Intravenous

pump units 17 or feeding tube pump units 17 can be clamped in the conventional manner onto the side bars of the vertical support unit 2. FIG. 3 depicts the removable utility platform 12 can be placed at either the left or right side of the front of the horizontal base unit 1, upon which a cardiac monitor 18 (see FIG. 2) or similar sized container can be placed for carrying.

5

FIGs. 1-3 depict the position and orientation of right and left adjustable hand support bars 4 which can be used to support full weight bearing as used with physical therapy parallel bars when held at the rear. Otherwise, when held at the front, the adjustable hand support bars 4 serve as hand holds while standing up from a chair, or for general steadyng and pushing the apparatus during 10 ambulation. FIGs. 2 and 3 depict the position of the right and left adjustable/removable elbow-rest platforms 19 which serve for partial or full weight bearing at the forearms and elbows during ambulation as used with the conventional device known as a platform walker.

FIGs. 1 and 2 reveal the position of the removable quadriceps exerciser strap 15, wrapped 15 across and around the right and left arms of the horizontal base frame 1, generally constructed of an adjustable nylon belt upon which the patient's feet are placed and anchored during quadriceps muscle extension exercise and knee flexion exercise.

QUADRICEPS EXERCISER AND KNEE RANGE OF MOTION: The position of the 20 quadriceps exercise strap 15 can be moved forward to Position A (FIG. 1) to reduce knee flexion at rest and to reduce difficulty in leg extension while the patient is attached and "swinging" in the harness unit 3. The quadriceps exerciser strap 15 can be moved back to Position B (FIG. 1) in order to increase knee flexion position at rest, and to increase the degree of difficulty in quadriceps extension while the patient is attached and "swinging" in the harness unit 3. The general therapeutic 25 exercise prescribed with the quadriceps exercise strap 15 is as follows: the patient is positioned such that he/she is in a more or less sitting position while "swinging" in the harness. Hands are placed in front holding on to the front portion of the horizontal hand support bars 4 which have been fanned upwards to the 90 degree position (see FIG. 1). The patient is asked to straighten his legs using knee/quadriceps extension while the feet are anchored upon the quadriceps exerciser strap 15 until a 30 rearward slanted standing position is achieved, at which time the patient can attempt to further arch his/her back so that hip extension can be achieved as well. Upon relaxation, the hips will again flex.

and the knees will again flex back to the original resting sitting position in the harness unit 3. This method of lower extremity exercise can be achieved, partially or fully, even in patients who cannot otherwise support their own weight during normal standing.

- 5        **UPPER EXTREMITY EXERCISE:** Using the position of "swinging" while attached and sitting in the harness 3, upper extremity exercise can also be achieved. While hands are placed in front holding on to the front portion of the horizontal hand hold support bars 4, the patient can pull his/her body forward while "swinging" in order to strengthen arm flexor (pulling) muscles. Upon release, the body will swing backwards back to the original resting position. The patient can also push his/her  
10      body away in order to strengthen arm extensor (pushing) muscles. Upon release, the body will swing forwards back to the original resting position. These sequences can be repeated as necessary to develop stamina. The degree of difficulty can also be increased by repositioning the horizontal hand hold support bars 4 forwards or backwards through the metal block clamps 8 prior to exercise. The change in position causes a change in distance through which the "swinging" body needs to be pulled  
15      or pushed, therefore the effort and strength necessary can be increased or decreased. Using these various adjustments, upper and lower extremity exercises in weak patients can be started with relatively easy exercise motions, and gradually increased as stamina and strength improve. Furthermore, these exercises can be started in patients who may not otherwise possess enough strength to ambulate.

20

- SELF-CENTERING MOTION:** The function of the "swinging" harness assembly design 3, 14 together with the freely castering/rolling wheels 5 allow the device to move rapidly and provide support should a patient fall during ambulation. The patient's fall produces a force away from the center of gravity of the ambulation device, transmitted by the adjustable harness support straps 14 to  
25      the top of the horizontal harness support bar 7 at the top of the apparatus. This force causes the entire apparatus to move in the direction of the patient's fall, thus bringing the apparatus again directly above the patient, at which time movement/rolling of the apparatus will stop. The patient is not allowed to fall due to the full support of the patient's weight by the harness assembly 3, 14. In addition, the apparatus cannot 'tip over' due to the design feature of short length of the adjustable  
30      harness support straps 14 during ambulation, which will not allow the patient's weight to move outside of the center of gravity of the entire apparatus.

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ACCESS TO AND FROM THE THERAPY ENVIRONMENT: The specific physical design configuration of the present invention allows access to various environments in the hospital or rehabilitation setting, namely the chair, wheelchair, commode, hospital bed, physical therapy mat exercise tables, exercise treadmill unit, the stationary bicycle exercise unit. Access to the chair, 5 wheelchair, hospital bed, or physical therapy mat exercise table can be accomplished regardless of the medical equipment which has already been placed for carrying upon the present invention.

CHAIR, COMMODE, WHEELCHAIR ACCESS: The rear opening of the rectangular base frame 1 allows the unit to be pushed backwards and straddle a convention chair, commode (portable or conventional), or convention wheelchairs of various sizes. This allows the rectangular vertical support unit 2 and horizontal harness support bar 7 to reach directly over the center of gravity of the sitting patient who is already wearing the suspension harness 3. Attachment to the harness 3 is made by attaching the carabiner rings 24 of the adjustable harness support straps 14. As the patient proceeds to stand up, the slack produced in the adjustable harness support straps 14 is 10 simultaneously taken in by the assisting nursing personnel. From the moment that the adjustable harness straps 14 are attached to the patient's suspension harness 3, the patient is protected from falling injury, even during the standing up procedure. At the end of an ambulation or exercise 15 session, the patient and the present invention are backed up to the chair, commode, or wheelchair, and the process described above is reversed.

20 The low sidebars of the horizontal rectangular based frame 1 also allow for access to the conventional hospital bed or physical therapy mat exercise tables. The entire apparatus can be rolled backwards to the side of the hospital bed or mat exercise table, pushing the rear of the rectangular base frame 1 under the bed/table until the vertical support unit 2 reaches the edge of said 25 bed or table. This places the vertical support unit 2 and the horizontal harness support bar 7 directly above the center of gravity of the sitting patient who is already wearing the suspension harness. The procedure to attach the harness 3 to the present invention and to assist the patient to stand up is identical to that procedure already described for the chair or wheelchair.

30 TREADMILL AND STATIONARY BICYCLE EXERCISE UNIT ACCESS: The rear opening of the rectangular horizontal base frame 1 also allows access to the treadmill exercise unit or the

stationary bicycle exercise unit. The present invention can be pushed backwards around and over the exercise treadmill unit or exercise bicycle unit. If necessary, the fully adjustable horizontal hand hold support bars 4 can be adjusted and/or rotated out of the way. The patient, already wearing the harness, must then ambulate up onto the inactive treadmill unit walking surface or onto the stationary bicycle unit. The harness support straps 14 are then attached to the patient's harness 3 by attaching the carabiner rings 24, and any excess slack in the adjustable harness straps 14 must be taken up. The patient can then begin exercise. In the event of undue fatigue, stumbling, or collapse during treadmill exercise, the patient's entire weight can be supported in a sitting position by the suspension harness assembly 3, 14 with the patient's feet safely above the treadmill's moving exercise surface.

10

For stationery exercise bicycle use, the present invention can provide protection from falling sideways, or the harness assembly 3, 14 tension may be adjusted as needed to reduce body weight pressure on the groin/pelvis caused by the exercise bicycle seat.

15

Alternatively, the patient can easily be placed into the present invention facing "backwards" (i.e. facing the open end of the rectangular base frame 1). Upon standing, the current invention and patient can simply walk up to and onto a treadmill exercise unit or stationary bicycle exercise unit while fully protected from falling injury before, during, and after exercise.

20

MOTORIZED VARIATION: A variation of the preferred embodiment of the present invention (not shown) utilizes a motorized unit which will mechanically pull or reel the adjustable harness support straps 14 while either attached or not attached to the suspension harness 3. This, in essence, will produce a motorized mechanical passive lifting device which is capable of partially assisting or fully "hoisting" a harnessed, seated, disabled patient into or out of a chair, wheelchair, commode, hospital bed, physical therapy mat, exercise table, or stationary exercise bicycle unit.

25

Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover in the appended claims all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above are hereby incorporated by reference.

CLAIMS

What is claimed is:

1. An ambulation, exercise, and passive lifting device comprising:
  - a base frame open on a side thereof;
  - a plurality of wheels attached to an underside of said base frame; and
  - a vertical support frame comprising horizontal L-shaped arms open on a side thereof coinciding with said open side of said base frame, said support frame removably attached to said base frame and capable of telescoping at a top end, said support frame further comprising:
    - a series of through-holes to accept securing pins to adjust heights of said arms;
    - a plurality of rods for suspending objects; and
    - a plurality of diagonal bracing rods attached at one end to said base frame and at another end to said support frame, said rods stabilizing said base frame and said support frame and permitting attachment of accessories.
2. The device of claim 1 wherein said arms are removably attached to said support frame and are individually adjustable with respect to height above a floor.
3. The device of claim 2 wherein said arms are additionally adjustable with respect orientation to one another.
4. The device of claim 2 wherein said arms are additionally adjustable with respect to points forward and rearward distances with respect to said support frame.
5. The device of claim 2 wherein said arms are additionally adjustable with respect to orientation with respect to the floor of forward portions of said arms.
6. The device of claim 1 additionally comprising a flexible horizontal exercise strap attached to said base frame, for use as a foot anchor and leg exerciser.

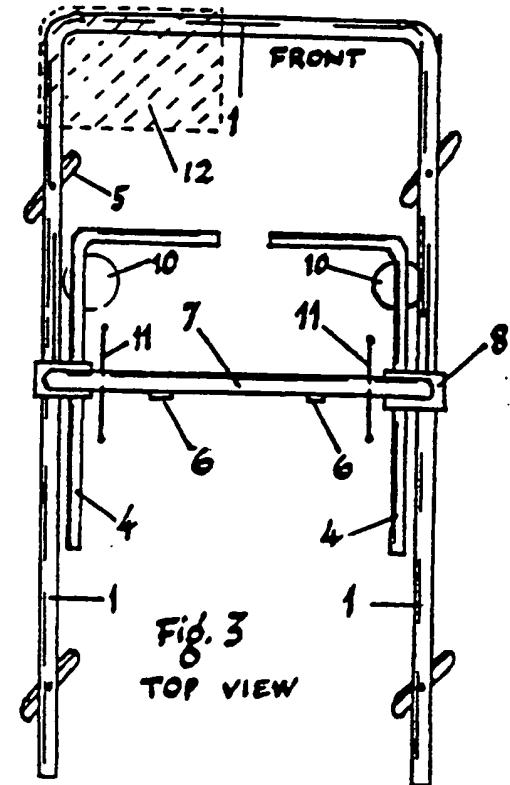
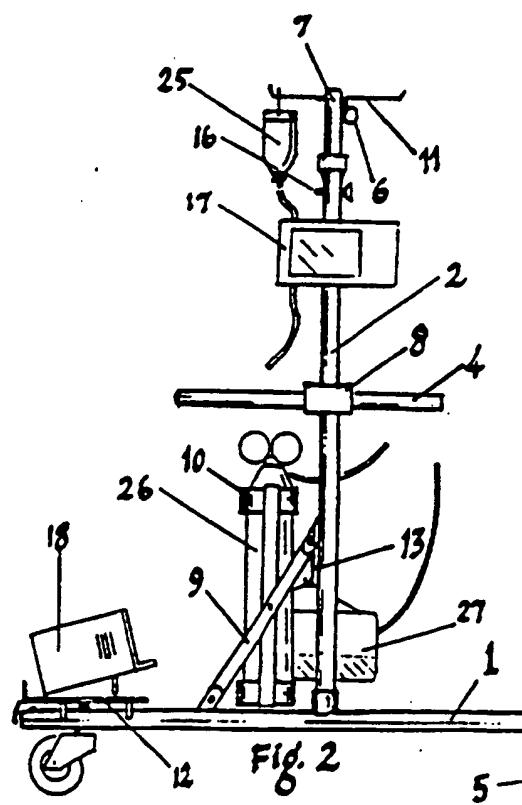
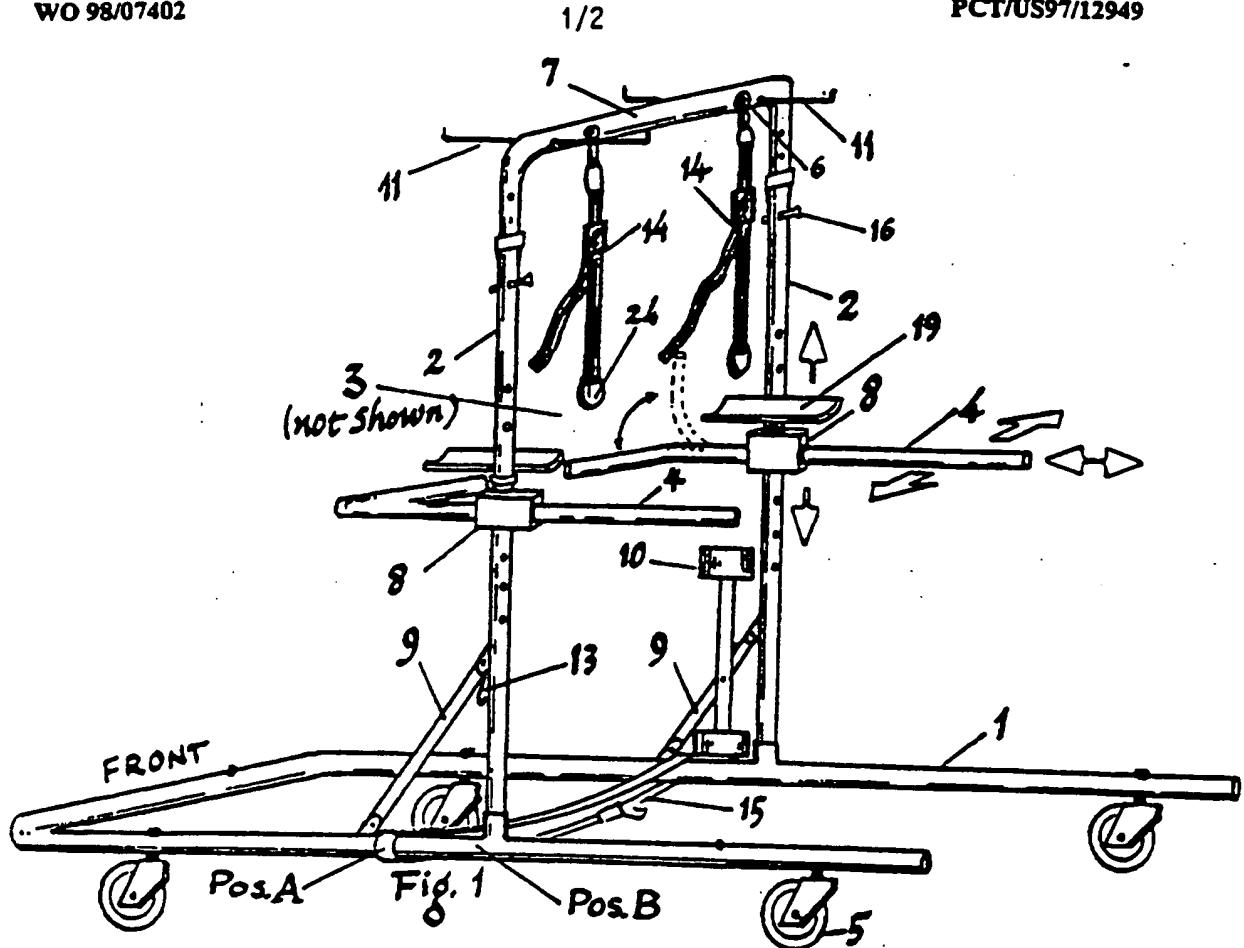
7. The device of claim 1 additionally comprising a suspension harness assembly attached to a top portion of said support frame for lifting and suspending a body and for prevention of the body from falling.
8. The device of claim 7 wherein said harness assembly comprises:
  - a plurality of anchors attached to said top portion of said support frame, each capable of fully supporting the weight of the human body;
  - a plurality of shoulder suspension straps which are fully adjustable with respect to length; and
  - a body harness.
9. The device of claim 8 wherein said body harness comprises a parachute harness.
10. The device of claim 1 additionally comprising an open cylindrical retaining device for securing and carrying an oxygen tank.
11. The device of claim 10 wherein said retaining device is removably attached to a bracing rod.
12. The device of claim 1 additionally comprising attachment means for supporting and carrying medical equipment.
13. The device of claim 12 wherein said attachment means is removably attached to a bracing rod.
14. The device of claim 1 additionally comprising a platform support for supporting weight of a body when an elbow of said body is placed thereon.
15. The device of claim 14 wherein said platform support is removably attached to a side of said support frame.

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16. The device of claim 1 additional comprising a platform for supporting medical devices.

17. The device of claim 16 wherein said platform is removably attached to a side of a front portion of said base frame.

18. The device of claim 1 wherein sides of said support frame which comprise columns for attaching and carrying a plurality of medical devices attachable to intravenous fluid provision poles.



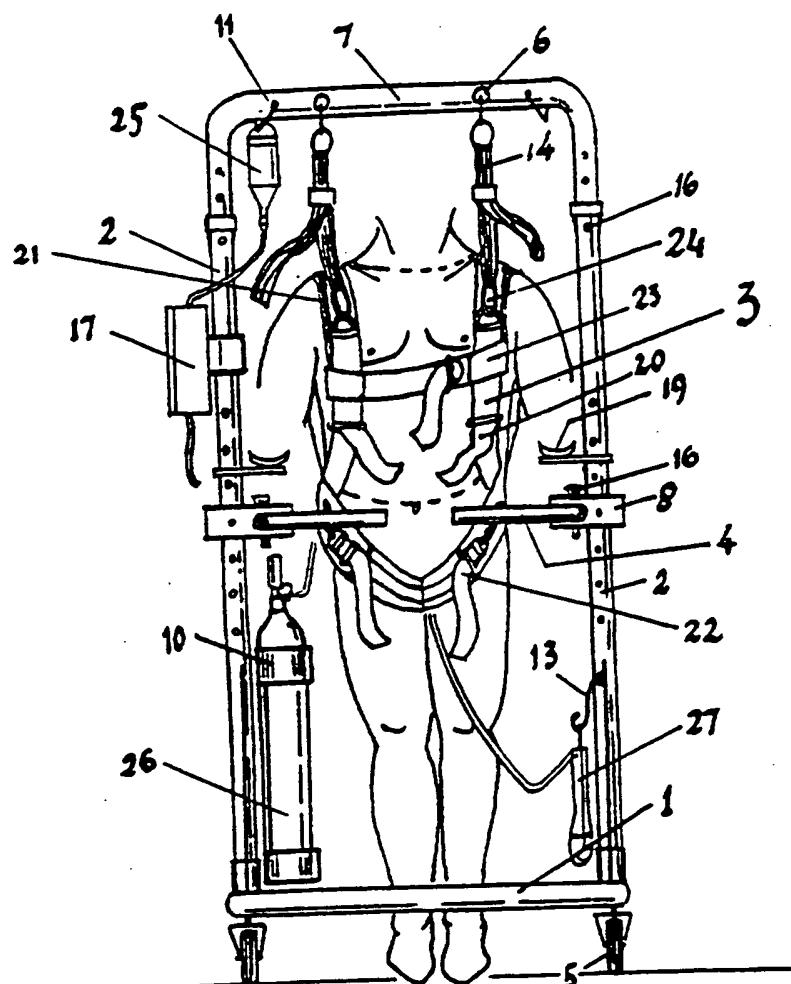


Fig. 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US97/12949

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A61H 3/04

US CL : 135/67

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 135/67, 65, 912; 280/87.041, 650, 657; 482/69

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,252,704 A (Wilson) 24 May 1966 (24/05/66), see entire document	1-18
Y	US 4,188,966 A (Palmer et al) 19 February 1980 (19/02/80), see entire document	1-18
Y,P	US 5,603,677 A (Sollo) 18 February 1997 (18/02/97), see entire document	1-18

 Further documents are listed in the continuation of Box C. See patent family annex.

Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but used to understand the principle or theory underlying the invention
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"P"	document published prior to the international filing date but later than the priority date claimed	

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